

What is claimed is:

1 1. A capacitive sensor for measuring a stimulus parameter, the sensor comprising:
2 a circuit board including at least one metallic layer;
3 a metallic diaphragm coupled to the circuit board and juxtaposed to the metallic
4 layer to thereby form a transducer capacitor characterized by a capacitance,
5 the metallic diaphragm being adapted to move relative to the at least one
6 metallic layer in response to a change in the stimulus parameter, whereby
7 the capacitance changes in accordance with the change in the stimulus
8 parameter; and
9 an oscillator circuit including a low-pass filter and coupled to the transducer
10 capacitor, the oscillator circuit being configured to generate a filtered signal
11 characterized by a frequency, whereby the frequency changes in accordance
12 with capacitance changes.

1 2. The sensor of claim 1, wherein the metallic diaphragm becomes substantially
2 curved in response to the stimulus parameter.

1 3. The sensor of claim 1 further comprising:
2 a conductive ring disposed between the metallic diaphragm and the circuit board;
3 and
4 a pressure port assembly coupled to the conductive ring, whereby a cavity is
5 formed between a pressure port and the metallic diaphragm.

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2 4. The sensor of claim 3, wherein the pressure port assembly further comprises:
3 a cap coupled to the conductive ring; and
4 a compressible sealer element disposed between the snap-on cap and the metallic
5 diaphragm, whereby substantially symmetrical forces are applied to the
metallic diaphragm to thereby seal the cavity.

1 5. The sensor of claim 4, wherein the compressible sealer element has a
2 substantially rectangular cross-section.

1 6. The sensor of claim 4, wherein the compressible sealer element includes an o-
2 ring.

1 7. The sensor of claim 3, wherein the circuit board includes a metallic land
2 disposed between the conductive ring and the circuit board, the metallic land being
3 adapted to support the conductive ring.

1 8. The sensor of claim 7, wherein the metallic land is co-planar with the at least one
2 metallic layer.

1 9. The sensor of claim 1, wherein the circuit board includes at least one guard ring
2 disposed within a thickness of the circuit board, the guard ring being adapted to reduce
3 stray capacitance between the metallic diaphragm and the metallic layer.

1 10. The sensor of claim 9, wherein the at least one guard ring mitigates the effects
2 of sensor performance variations due to temperature induced variations of a dielectric
3 constant of the circuit board.

1 11. The sensor of claim 1, wherein the low-pass filter includes an impedance
2 element coupled to a first shunt capacitor.

1 12. The sensor of claim 11, wherein the impedance element includes a resistor, or
2 an inductor, or both.

1 13. The sensor of claim 11, wherein the first shunt capacitor is coupled to AC
2 ground.

8 generating a non-sinusoidal signal having a frequency, whereby the frequency is
9 proportional to the stimulus parameter.

1 22. The sensor of claim 21, further comprising:
2 a first circuit loop disposed in series with the capacitor transducer, the first circuit
3 loop providing a non-inverting gain to the filtered signal; and
4 a second circuit loop disposed in parallel with the capacitor transducer, the second circuit
5 loop providing an inverting gain to the filtered signal.

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23. The sensor of claim 21, wherein the environmental parameter is fluid pressure.

1 24. The sensor of claim 23, further comprising:
2 a circuit board including at least one metallic layer; and
3 a metallic diaphragm coupled to the circuit board and juxtaposed to the metallic
4 layer to thereby form the variable capacitor transducer, the metallic
5 diaphragm being adapted to move relative to the at least one metallic layer
6 in response to a change in the fluid pressure, whereby the variable
7 capacitance changes in accordance with the change in the fluid pressure.

1 25. The sensor of claim 24, further comprising a first capacitor coupled to the
2 transducer capacitor to thereby form a capacitance divider with an inter-plate capacitance
3 generated between the fixed plate member and a variable plate member.

1 26. The sensor of claim 21, wherein the low-pass filter includes a shunt capacitor
2 and a resistor.

1 27. The sensor of claim 21, wherein the stimulus parameter is pressure.

1 28. The sensor of claim 21, wherein the stimulus parameter is force.

1 29. The sensor of claim 21, wherein the stimulus parameter is displacement.

the ground conductor layer and the metallic diaphragm shield the two co-planar rings from
4 AC-signals

1 37. The system of claim 31, wherein the processor includes a gain correction
2 circuit, the gain correction circuit being configured to multiply a number representing the
3 frequency by a correction factor.

1 38. The system of claim 37, wherein the correction factor equals an initial zero-
2 pressure frequency value divided by an ambient zero-pressure frequency value.

1 39. The system of claim 31, wherein the processing circuit includes a counter
2 circuit configured to determine the frequency of the filtered signal.

1 40. The system of claim 39, wherein the counter circuit employs a frequency
2 counting method.

1 41. The system of claim 39, wherein the counter circuit employs a period averaging
2 method.

1 42. The system of claim 39, wherein the counter circuit employs a period averaging
2 method that counts frequency pulses within a sampling period.

1 43. The system of claim 42, wherein the period averaging method determines the
2 frequency by solving the equation, $\text{frequency} = \text{Fref} * [(N_n - N_{n-1}) / (M_n - M_{n-1})]$,
3 wherein n is the sampling period, $N_n - N_{n-1}$ is a number of pulses counted in the sampling
4 period, and $M_n - M_{n-1}$ is a number of clock periods occurring during sampling period n .

1 44. The system of claim 43, wherein Fref is a constant.

1 45. The system of claim 43, wherein Fref is a reference frequency.

1 46. The system of claim 31, wherein the stimulus parameter is pressure.

1 47. The system of claim 31, wherein the stimulus parameter is force.

1 48. The system of claim 31, wherein the stimulus parameter is displacement.

1 49. A method for calibrating a capacitive sensor used to measure a stimulus
2 parameter, the method comprising:

3 providing a sensor including a capacitor transducer and an oscillator circuit, the
4 capacitor transducer being characterized by a variable capacitance that
5 varies in accordance with a change in the stimulus parameter;

6 determining a correction factor by comparing an initial condition to an ambient
7 condition;

8 determining the frequency corresponding to the stimulus parameter during ambient
9 conditions; and

10 correcting the stimulus parameter by multiplying the correction factor by the
11 frequency, whereby a corrected frequency value is obtained.

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50. The method of claim 49, wherein the step of determining further comprises the
2 steps of:

3 obtaining an initial condition factory oscillation frequency value (f_0);

4 obtaining an initial condition ambient condition frequency value (f_1); and

5 dividing the initial condition factory oscillation frequency value by the initial
6 condition ambient condition frequency value.

1 51. The method of claim 50, wherein the initial condition factory oscillation
2 frequency value is obtained when the sensor is configured in a zero stimulus state.

1 52. The method of claim 50, wherein the initial condition ambient oscillation
2 frequency value is obtained when the sensor is configured in a zero stimulus state.

1 53. The method of claim 50, wherein the correction factor equals, $C = f_0/f_1$.

1 54. The method of claim 53, wherein the corrected frequency equals, $f_c = C * f_s$, f_s
2 being the frequency corresponding to the stimulus parameter during ambient conditions.

1 55. The method of claim 49, wherein the stimulus parameter is pressure.

1 56. The method of claim 49, wherein the stimulus parameter is force.

1 57. The method of claim 49, wherein the stimulus parameter is displacement.

1 58. The method of claim 49, wherein the stimulus parameter is humidity.

1 59. A capacitive pressure sensor for measuring a stimulus parameter, the sensor
2 comprising:

3 a circuit board including at least one metallic layer;

4 a metallic diaphragm coupled to the circuit board and juxtaposed to the metallic

5 layer to thereby form a transducer capacitor characterized by a capacitance,

6 the metallic diaphragm becoming substantially curved relative to the at least

7 one metallic layer in response to a change in the stimulus parameter such

8 that the capacitance changes in accordance with stimulus parameter

9 changes; and

10 an oscillator circuit coupled to the transducer capacitor, the oscillator circuit being

11 configured to generate a signal characterized by a frequency that changes in

12 accordance with capacitance changes.

1 60. A capacitive sensor for measuring a stimulus parameter, the sensor comprising:

2 a circuit board including at least one metallic layer;

3 a metallic diaphragm coupled to the circuit board and juxtaposed to the metallic

4 layer to thereby form a transducer capacitor characterized by a capacitance,

5 the metallic diaphragm being adapted to move relative to the at least one

6 metallic layer in response to a change in the stimulus parameter such that
7 the capacitance changes in accordance with stimulus parameter changes;
8 a conductive ring disposed between the metallic diaphragm and the circuit board;
9 a pressure port assembly coupled to the conductive ring, whereby a cavity is
10 formed between a pressure port and the metallic diaphragm; and
11 an oscillator circuit coupled to the transducer capacitor, the oscillator circuit being
12 configured to generate a signal characterized by a frequency that changes in
13 accordance with capacitance changes.

1 61. A capacitive sensor for measuring a stimulus parameter, the sensor comprising:
2 a circuit board including at least one metallic layer;
3 a metallic diaphragm coupled to the circuit board and juxtaposed to the metallic
4 layer to thereby form a transducer capacitor characterized by a capacitance,
5 the metallic diaphragm being adapted to move relative to the at least one
6 metallic layer in response to a change in the stimulus parameter such that
7 the capacitance changes in accordance with stimulus parameter changes;
8 at least one guard ring disposed within a thickness of the circuit board, the guard
9 ring being adapted to reduce stray capacitance between the metallic
10 diaphragm and the metallic layer; and
11 an oscillator circuit coupled to the transducer capacitor, the oscillator circuit being
12 configured to generate a signal characterized by a frequency that changes in
13 accordance with capacitance changes.

1 62. A capacitive sensor for measuring a stimulus parameter, the sensor comprising:
2 a circuit board including at least one metallic layer;
3 a metallic diaphragm coupled to the circuit board and juxtaposed to the metallic
4 layer to thereby form a transducer capacitor characterized by a capacitance,
5 the metallic diaphragm not including an attached metallic plate, the metallic
6 diaphragm being adapted to move relative to the at least one metallic layer
7 in response to a change in the stimulus parameter such that the capacitance
8 changes in accordance with stimulus parameter changes; and

9 an oscillator circuit coupled to the transducer capacitor, the oscillator circuit being
10 configured to generate a signal characterized by a frequency that changes in
11 accordance with capacitance changes.